International Journal of Environment, Ecology, Family and Urban Studies (IJEEFUS)
ISSN (P): 2250-0065; ISSN (E): 2321-0109
Vol. 8, Issue 5, Oct 2018, 9-14

ELEPHANT CONFLICT HOTSPOTS IN COFFEE AGROFORESTRY IN KODAGU DISTRICT, KARNATAKA

THAMMAIAH. C. K. & VIJAYA KUMARA

Department of Wildlife and Management, JnanaSahyadri, Kuvempu University, Shimoga, Karnataka, India,

ABSTRACT

Conflicts are the normal phenomenon along the forest boundary in Kodagu with the difference in land use pattern. Kodagu with the larger shade grew coffee estate with the company to the small planters makes the desirable condition for the elephant to feed on the cultivated crops and the grass grown in the area. The study was carried out know the area which has a high concentration of conflicts known as hotspots of conflict in coffee Agroforestry. To assess the hotspot of conflicts Getis-Ord Gi* statistics were used. GPS location of the elephant in the coffee estate shows the presence of the conflicts location, GPS points collected over a season will the represent the highly conflicted area within the study area, these areas are the crucial to know for the management proposed for driving the elephant from the coffee estate towards the forest to reduce the conflicts. Throughout the study period conflicts points concentrationfallon the same location showing regular conflicts within the small area traveling small distance this could be depending the food source and the safety of the elephant in the day time. Conflicts have increase in these areas as the elephant covering new areas. When forest ground stafs drive away the elephant they creat more damage. The result can be used for the feature mitigation management work giving more importance to the hotspot of conflicts and for the indetail study on human elephant conflicts in micro level to reduce the conflicts.

***KEYWORDS**: Human Elephant Conflicts, Hotspot Analysis, Coffee Estate, GPS Location & Getis-Ord Gi Statistics*

Received: Aug 02, 2018; **Accepted:** Aug 22, 2018; **Published:** Sep 04, 2018; **Paper Id.:** IJEEFUSOCT20182

Original Article

INTRODUCTION

India holds the largest population of wild Asian elephants (*Elephasmaximus*) with nearly 27,000–29,000 animals found in the country (MOEF, 2010). In the early 1980s, due to the stringent protection offered by law-enforcement agencies, some of the protected areas (PAs) in southern India recovered from poaching and other threats, resulting in high densities of elephants (AERCC, 1998). The Gajasastra (‘elephant lore’ in Sanskrit) records the devastation of crops by elephants during the sixth and fifth centuries BC (Sukumar, 1989). Crop damage, human deaths are the main reasons for the hatred that has developed towards the elephant. Human demographic pressure, expansion of cash crops in previously forested areas and the subsequent overlap of habitats, has led to the widespread exclusion of elephants from their previous ranges (Hoare et al, 1999; Parker et al, 1989; Sukumar, 2006). Kodagu district is a major coffee-growing region in the Western Ghats of the State of Karnataka. It produces 2% of the world’s coffee, essentially in complex, multistory Agroforestry systems (Coffee Board of India, 2008). The 1,588 km^2 of state-controlled forests in Kodaguharbour an estimated 1,730 elephants (Nath et al, 1998). The district is surrounded by forests in a continuous belt that holds the single largest contiguous population of Asian elephants, with an estimated 9,000 individuals (Sukumar, 1989; Vidya et al, 2005). The region has 1–3 elephants per km^2, one of the highest elephant densities in Asia (Kemf et al, 2000).

Along with labour costs and coffee price fluctuations, human-elephant conflict (HEC) is highlighted by local stakeholders as one of the three main problems faced by farmers (Garcia et al, 2010). Previous studies on HEC in Kodagu (Nath et al, 1998; Kulkarni et al, 2007; Bhoominathan et al, 2008), have described the regional pattern of conflict and crop strategies developed by coffee planters and institutions such as the Karnataka Forest Department (KFD) to tackle HEC. The combined effects of high elephant density and major landscape changes due to the expansion of coffee cultivation are the cause of human-elephant conflicts (Baletal, 2011). Mitigation strategies that include electric fencing and compensation schemes implemented by the forest department have met with limited success (Balet al, 2011). The increase in the human-elephant interface has caused an increase in conflict (Nelson et al, 2003). In this paper, we used a GIS hotspot tool to assess the high concentration of elephant conflicts in the study area through spatial statistics in geographical information technology. This method helps to identify the zone where the stakeholders are affected by the elephant and to take mitigation measure work to control the conflicts.

Study Area

The district of Kodagu is situated on the southwestern border of Karnataka state in south India selected study area has a mosaic of coffee, Areca paddy cultivation area apart from paddy cultivation in low land plantation owner also grows ginger banana and also to convert the land in the coffee plantation or abandoned the paddy cultivation. These share the common boundary with forest land which has evergreen to semi-evergreen forest type which is the west of the Kodagu district where Western-Ghats lies, between ($11^0$55 min – $12^0$50 min N and $75^0$21min – $76^0$15 min E) covers Brahmageri, Talacavery and Pushapageri wildlife sanctuaries (Figure 1). The southern tip of Brahmageri extend to Kerala Wynad north division where the Tirunilli reserved forest and Kudrakate reserved forest provide a narrow connection eastward to the Tholpathy range of Wynad sanctuary. This is an extremely important corridor to maintain habitat contiguity for elephant population in Western-Ghatsjoin the Niligeri Biosphere.

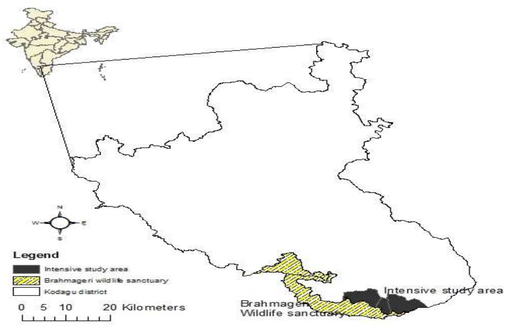

Figure 1: Map of Kodagu District Showing the

Intensive Study Area

METHODOLOGY

All the data on human-elephant conflicts were collected from fieldwork conducted from January 2014 to December 2016. In this period of conflict incident, GPS location was collected. One GPS location was considered for a day as the elephant tends to move from one place to another plantation depending upon the food source and disturbance done by forest field staff and landowner. Information of elephant presence was collected from plantation owner or from forest field staff. As the elephant does not move much in the coffee plantation in the daytime it is easy to locate the elephant from

the tree top, as we confirm the presence GPS location is taken for the present day. The same method is followed if there is a different group of the elephant in another location within the study area. If the second location of the elephant presence is too far from the present location, then that location is considered as valid information to collect details of the conflicts. So there will not be too many points of the same location in one day, resulting in falls information of the conflicts. A 500sqmts grid was alayer on the study area as it has undulating terrain with the low land as wetlands and elevated land with coffee plantation (Figure 2).

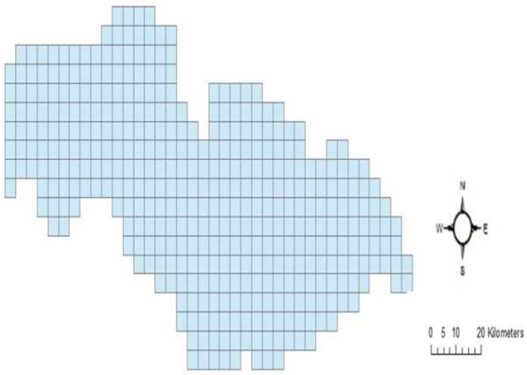

Figure 2: Map Showing the 500sqmts Grid in the Study Area

Hotspot Analysis

A hotspot is a location or a small area with an identifiable boundary showing the concentration of incident (ESRI online resources). There is three major processes involved in the human-elephant conflicts estimation are a collection of incident location, mapping of clusters and using Getis – OrdGi* function. All the conflict points are joined to the polygon to result in a new weight polygon feature call with a field count that indicates the number of conflicts occurs in the polygon. This feature was used as the input feature to run the hotspot tool (Getis – OrdGi*) to identify each polygon with high value or with a low-value cluster in the study area, this tool works by considering each feature within the context of the neighbouring feature. If the feature value is high and the value of its entire neighbouring feature is also high it is a part of the hotspot. The statistical equation for calculating GI* written as

$$Gi^*(d) = \frac{\sum j \; W_{ij}(d)\, x_j - W^*_i \overline{x}^*}{s^* \left\{ \left[\left(nS^* 1i \right) - W_i^{*2} \right] / (n-1) \right\}^{1/2}}$$

Where $W_{ij}(d)$ is a spatial weight vector with value for all cell ‘j’ within distance d of target cell i, w^*_I is the sum of weight, S^*_{Ii} is the sum of square weight and S^* is the standard deviation of the data in the cell.

To identify the spatial clusters of the hotspot and cold spot statistical tools of Getis – OrdGi*was used. Hotspot analysis tool, output is Z score and P value for the given feature. These output values of Z score and P value are statistical significance of the spatial clustering of value. A high Z score and small P value of a feature indicating a spatial clustering of low values. The higher or lower the Z scores the more intense the clustering. A Z score near zero indicates no apparent spatial Clustering (destop.arcgis.com/en/arcmap/10.3/tools/spatial-statistics-toolbox/hot-spot-analysis.html).

RESULTS

A total of 26 conflicts points was considered for the hotspot analysis within the coffee plantation. These plantations are very close to the forest boundary and a private forest land (uncultivated coffee plantation) sharing the common boundary where the elephant enters the cropland. The hotspot estimation to know the frequent conflicts occurrence site for any reason were calculated using the Getis – OrdGi* method with the event calculation. A total of 399 grids were present in the study area within the 399 grind only 93 grids had the 262 conflicts incident within the 93 grid with a maximum of 12 incident and a minimum of 0 incidents where there was no elephant movement (Figure 4). The Z score for the total conflicts incident was varied from 0.9300 to 8.931 and P value from 0 to 0.352. From this value, it is inferred that statistically significant positive Z score having high values indicating elephant conflict hotspot which means higher the conflicts rate and statistically significant negative Z score having a low value indicating the cold spot where the conflicts are very less or no conflicts occurrence. As we counted the maximum number of the conflicted incident with the grid have a high Z score of 8.931 while grid having 1 count incident having the low Z scores of 0.203. (Figure 3)

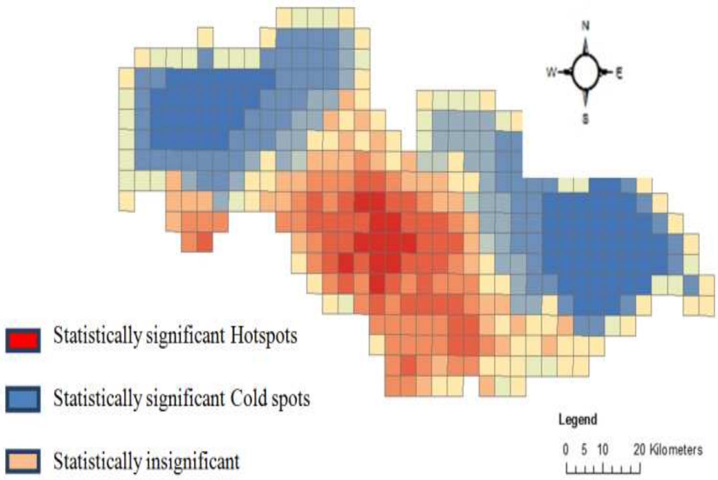

Figure 3: A Grid Map Showing Elephant Conflicts Incidents Hotspot

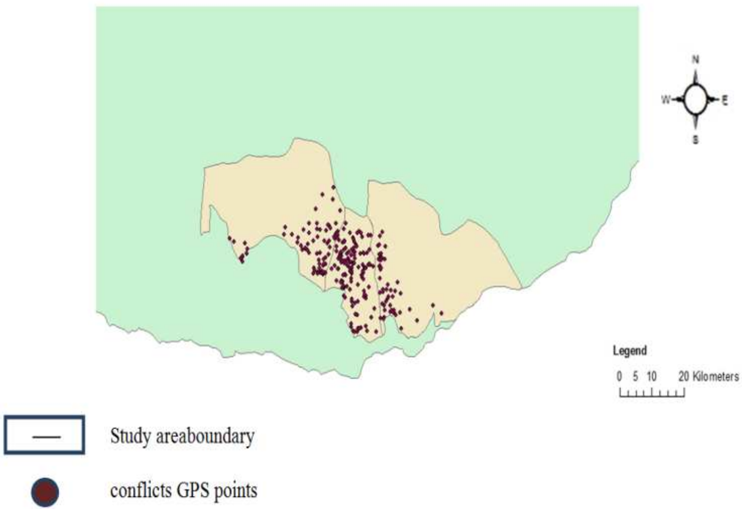

Figure 4: Study Area Map with the Conflicts GPS Points

DISCUSSIONS

Incidents of human-elephant conflicts are increasing every year. In the past two years, elephants were using same estate and the path to move within the estate. In Virajpet forest division conflicts are increasing from 2005 (Baletal., 2011). Our result shows that an elephant intensively using a particular grid where the Z score of 8.931 which had 12 conflicts incident. More the elephant uses the same place it shows that there are food availability and safe habitat for the elephant as they move less in the daytime. A study conducted in Africa and Asia has revealed the correlation between elephant conflicts with elephant density (Hoare 1999). Future studies required to understand why elephant visits the same place while raiding crops. As this study identifies the hotspot and cold spots to a given area this result can be used for the future studies in these conflict zones.

CONCLUSIONS

We have zero down the high and low (hotspots and cold spots) conflicts area, it is the kind of the best approach to give more importance to the area having more conflicts as the result are statistically significant and shows the area have spatial clustering. Hotspot analysis of Getis – OrdGi* result can be effectively used for the management of conflicts and reduce the conflicts. Micro-level studies can be planned for the implementation of mitigation measures.

REFERENCES

1. *AERCC, (1998). Asian Elephant in Southern India: A GIS Database for conservation of Project Elephant Reserves. Asian Elephant Research and Conservation Centre (AERCC). Bangalore, India.*
2. *Bhoominathan, D., Mohanraj, N., Aziz, T.,* and *A Desai, (2008). Humanelephant conflict in Somwarpet Subdivision (Madikeri Forest Division), final report. WWF-India, Madikeri, India, 52.*
3. *Bal, P., Nath, C. D., Nanaya, K. M., Kushalappa, C. G.,* and *C. Garcia, (2011). Elephants Also Like Coffee: Trends and Drivers of Human–Elephant Conflicts in Coffee Agroforestry Landscapes of Kodagu, Western Ghats, India.*
4. *Coffee Board of India, (2008). Database on coffee. Economic and Market Intelligence Unit, Bangalore, 108.*
5. *ESRI. ESRI online help for spatial statistics and analysis. http://resource.esri.com/help/10.3/aregisdesktop/com/.*
6. *Garcia, C., Bhagwat, S. A., Ghazoul, J., Nath, C. D., Nanaya, K. M., Kushalappa, C. G., Raghuramulu, Y., Nasi, R.,* and *P. Vaast, (2010). Biodiversity conservation in agricultural landscapes: challenges and opportunities of coffee agroforests in the Western Ghats, India. Conservation Biology 24:479–488.*
7. *Hoare, RE., (1999). Determinants of human-elephant conflict in a land use mosaic. Journal of Applied Ecology, 36, 689-700.*
8. *Hoare, RE.,* and *JT. Du Toit., (1999). Coexistence between people and elephants in African savannas. Conservation Biology 13:633–639.*
9. *Kemf, E.,* and *Santiapillai, C.,* (2000). *Asian elephants in the wild: A WWF species status report. WWF International, Switzerland, 32.*
10. *Kulkarni, J., Mehta, P., Bhoominathan, D.,* and *S. Chaudhuri, (2007). A study of man-elephant conflict in Nagarhole National Park and surrounding areas of Kodagu district in Karnataka, India, Final report. Envirosearch, Pune, 126.*
11. *Ministry of Environment and Forests, (2010). Gajah: Securing the Future for Elephants in India. Government of India, New Delhi, India.*

12. *Nath, CD.,* and *R. Sukumar,* (*1998*). *Elephant-human conflict in Kodagu, southern India: distribution patterns, people's perceptions and mitigation methods. Asian Elephant Conservation Centre, Bangalore, India, 62.*

13. *Nelson, A., Bidwell, P.,* and *C. Sillero-Zubiri,* (*2003*). *A review of human elephant conflict management strategies. People and Wildlife Initiative Wildlife Conservation Research Unit. Oxford University, Oxford, 25.*

14. *Parker ISC.,* and *AD. Graham,* (*1989*). *Elephant decline: downward trends in African elephant distribution and numbers. Part I. International Journal of Environmental Studies 34:287–305.*

15. *Sukumar, R.,* (*1989*). *The Asian elephant: ecology and management. Cambridge studies in applied ecology and resource management. Cambridge University Press, Cambridge, 255.*

16. *Sukumar, R.,* (*2006*) *A brief review of the status, distribution and biology of wild Asian elephants Elephasmaximus. International Zoo Yearbook 40:1–8*

17. *Vidya TNC,* Fergnando *P, Melnick DJ,* and *R. Sukumar,* (*2005*). *Population differentiation within and amongst Asian elephant (Elephasmaximus) populations in southern India. Heredity 94:71–80.*